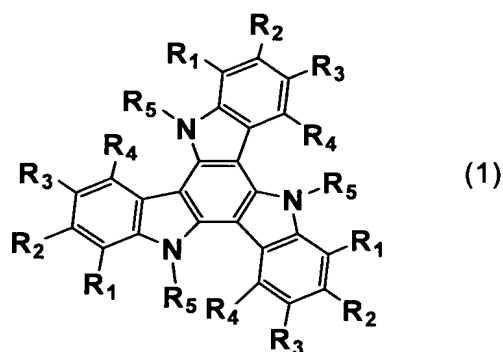


Claims

[1] A substituted Sym-triindole derivative represented by the following general formula (1)

[formula 1]



5 (wherein R₁, R₂, R₃ and R₄ are each independently hydrogen, halogen, C1-C6 alkyl group, C1-C6 haloalkyl group, substituted C1-C6 alkyl group, C2-C6 alkenyl group, substituted C2-C6 alkenyl group, C2-C6 alkynyl group, substituted C2-C6 alkynyl group, hydroxyl group, C1-C6 alkoxy group, aryloxy

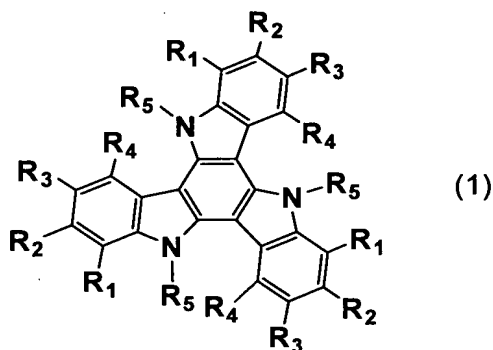
10 group, amino group, mono-substituted amino group, di-substituted amino group, acylamino group, mercapto group, C1-C6 alkylsulfenyl group, C1-C6 haloalkylsulfenyl group, arylsulfenyl group, substituted arylsulfenyl group, C1-C6 alkylsulfinyl group, C1-C6 haloalkylsulfinyl group, aralkylsulf-

15 enyl group, arylsulfinyl group, substituted arylsulfinyl

group, C1-C6 alkylsulfonyl group, C1-C6 haloalkylsulfonyl group, arylsulfonyl group, substituted arylsulfonyl group, sulfonic acid group (hydroxysulfonyl group), aryl group, substituted aryl group, cyano group, nitro group, formyl group, acyl group, carboxyl group, C1-C6 alkoxy carbonyl group, carbamoyl group, N-mono-substituted carbamoyl group, N,N-disubstituted carbamoyl group, hydrazonomethyl group ($-\text{CH}=\text{N}-\text{NH}_2$ group), N-mono-substituted hydrazonomethyl group, N,N-disubstituted hydrazonomethyl group, oximemethyl group (hydroxyiminomethyl group), C1-C6 alkoxyiminomethyl group, or aryloxyiminomethyl group; R_5 is C2-C12 alkyl group, substituted C2-C12 alkyl group, C2-C12 haloalkyl group, or aryl C1-C6 alkyl group; in no event, all of R_1 , R_2 , R_3 and R_4 are hydrogen simultaneously).

[2] A process for producing a substituted Sym-triindole derivative represented by the following general formula (1)

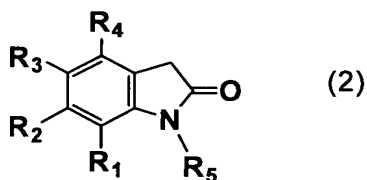
[formula 3]



(wherein R_1 , R_2 , R_3 and R_4 are each independently hydrogen, halogen, C1-C6 alkyl group, C1-C6 haloalkyl group, substituted C1-C6 alkyl group, C2-C6 alkenyl group, substituted C2-C6 alkenyl group, C2-C6 alkynyl group, substituted C2-C6 alkynyl group, hydroxyl group, C1-C6 alkoxy group, aryloxy group, amino group, mono-substituted amino group, di-substituted amino group, acylamino group, mercapto group, C1-C6 alkylsulfenyl group, C1-C6 haloalkylsulfenyl group, aralkylsulfenyl group, arylsulfenyl group, substituted arylsulfenyl group, C1-C6 alkylsulfinyl group, C1-C6 haloalkylsulfinyl group, arylsulfinyl group, substituted arylsulfinyl group, C1-C6 alkylsulfonyl group, C1-C6 haloalkylsulfonyl group, arylsulfonyl group, substituted arylsulfonyl group, sulfonic acid group (hydroxysulfonyl group), aryl group, substituted aryl group, cyano group, nitro group, formyl group,

acyl group, carboxyl group, C1-C6 alkoxy carbonyl group, carbamoyl group, N-mono-substituted carbamoyl group, N,N-disubstituted carbamoyl group, hydrazonomethyl group ($-\text{CH}=\text{N}-\text{NH}_2$ group), N-mono-substituted hydrazonomethyl group, N,N-disubstituted hydrazonomethyl group, oximemethyl group (hydroxyiminomethyl group), C1-C6 alkoxyiminomethyl group, or aryloxyiminomethyl group; R_5 is C2-C12 alkyl group, substituted C2-C12 alkyl group, C2-C12 haloalkyl group, or aryl C1-C6 alkyl group; in no event, all of R_1 , R_2 , R_3 and R_4 are hydrogen simultaneously), which process comprises reacting a substituted oxyindole represented by the following general formula (2)

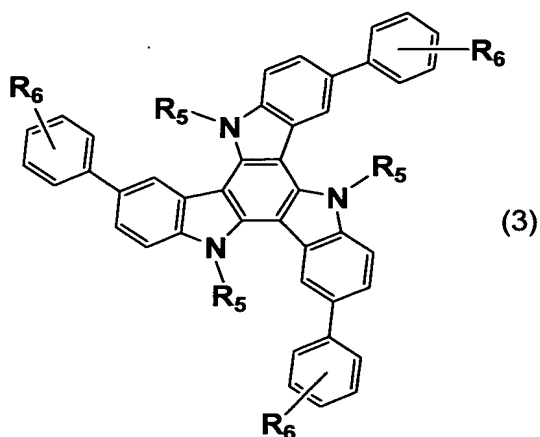
[formula 2]



(wherein R_1 , R_2 , R_3 , R_4 and R_5 have the same definitions as given above) with a phosphorus oxyhalide.

[3] A Sym-triindole derivative represented by the following general formula (3)

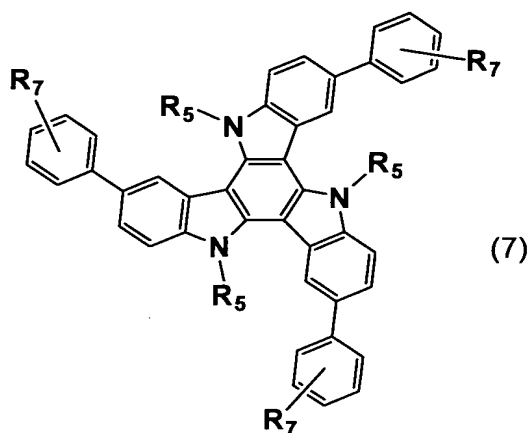
[formula 4]



(wherein R₅ is C2-C12 alkyl group, substituted C2-C12 alkyl group, C2-C12 haloalkyl group, or aryl C1-C6 alkyl group; and R₆ is hydrogen, formyl group, cyano group, C1-C6 alkoxy-
5 carbonyl group, dicyanovinyl group, aryl group or substituted aryl group).

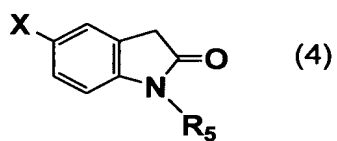
[4] A process for producing a Sym-triindole derivative represented by the following general formula (7)

[formula 8]



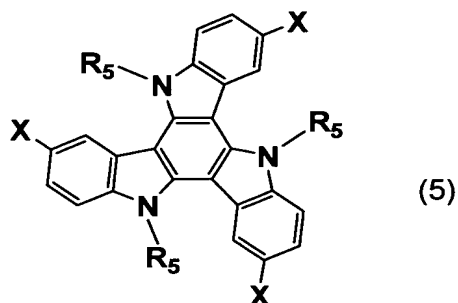
(wherein R_5 is C2-C12 alkyl group, substituted C2-C12 alkyl group, C2-C12 haloalkyl group or aryl C1-C6 alkyl group; and R_7 is hydrogen, formyl group, cyano group, C1-C6 alkoxy-carbonyl group, aryl group or substituted aryl group), which
 5 process comprises reacting an N-substituted-5-halo-oxyindole represented by the following general formula (4)

[formula 5]



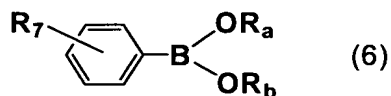
(wherein R_5 has the same definition as given above; and X is halogen) with a phosphorus oxyhalide to obtain an N-substituted-5-halo-triindole derivative represented by the
 10 following general formula (5)

[formula 6]



(wherein R₅ and X have the same definitions as given above)
and further reacting it with a boric acid compound represented by the following general formula (6)

[formula 7]

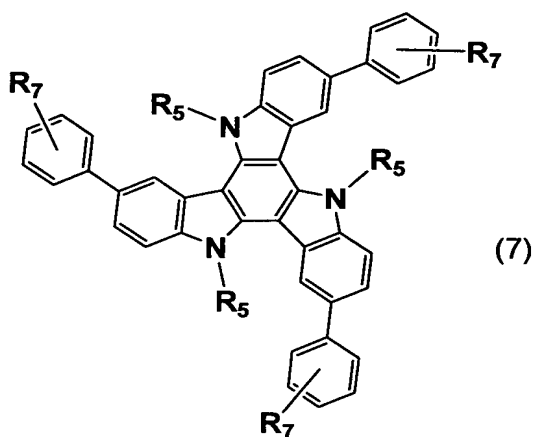


5 (wherein R₇ has the same definition as give above; and R_a and R_b are each independently hydrogen atom, C1-C6 alkyl group or optionally substituted phenyl group and may be combined to each other to form a ring).

[5] A process for producing a Sym-triindole derivative represented by the following general formula (7)

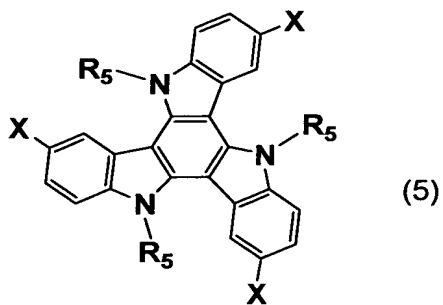
10

[formula 11]



(wherein R_5 is C2-C12 alkyl group, substituted C2-C12 alkyl group, C2-C12 haloalkyl group or aryl C1-C6 alkyl group; and R_7 is hydrogen, formyl group, cyano group, C1-C6 alkoxy-carbonyl group, aryl group or substituted aryl group), which
 5 process comprises reacting an N-substituted-5-halo-triindole derivative represented by the following general formula (5)

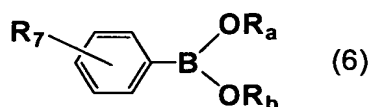
[formula 9]



(wherein R_5 has the same definition as given above; and X is halogen) with a boric acid compound represented by the fol-

lowing general formula (6)

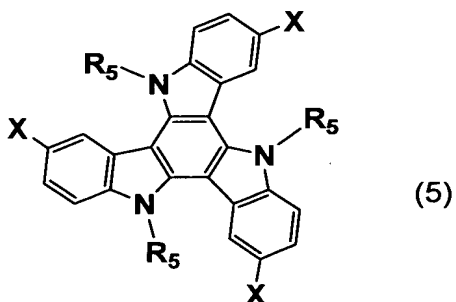
[formula 10]



(wherein R₇ has the same definition as given above; and R_a and R_b are each independently hydrogen atom, C1-C6 alkyl group or optionally substituted phenyl group and may be combined to each other to form a ring).

[6] A process for producing an N-substituted-5-halo-triindole derivative represented by the following general formula (5)

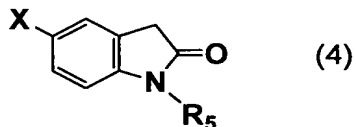
10 [formula 13]



(wherein R₅ is C2-C12 alkyl group, substituted C2-C12 alkyl group, C2-C12 haloalkyl group or aryl C1-C6 alkyl group; and X is halogen), which process comprises reacting an N-

substituted-5-halo-oxyindole represented by the following
general formula (4)

[formula 12]

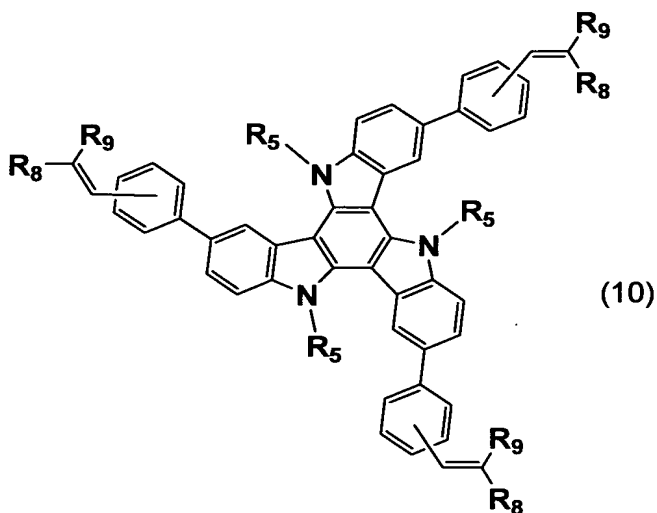


(wherein R₅ and X have the same definitions as given above)

5 with a phosphorus oxyhalide.

[7] A process for producing a Sym-triindole derivative represented by the following general formula (10)

[formula 16]

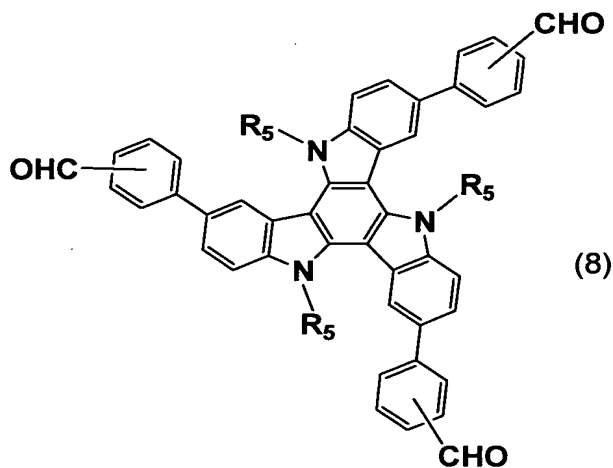


(wherein R₅ is C2-C12 alkyl group, substituted C2-C12 alkyl
10 group, C2-C12 haloalkyl group or aryl C1-C6 alkyl group; R₈

is hydrogen or cyano group; and R₉ is cyano group, carboxylic acid group, C1-C6 alkoxy carbonyl group, aryl group or substituted aryl group), which process comprises reacting a triindole derivative represented by the following general formula

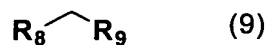
5 (8)

[formula 14]



(wherein R₅ has the same definition as given above) with a methylene compound represented by the general formula (9)

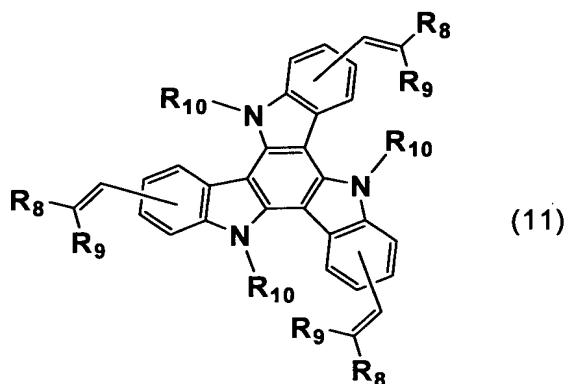
[formula 15]



10 (wherein R₈ and R₉ have the same definitions as give above).

[8] A Sym-triindole vinyl derivative represented by the following general formula (11)

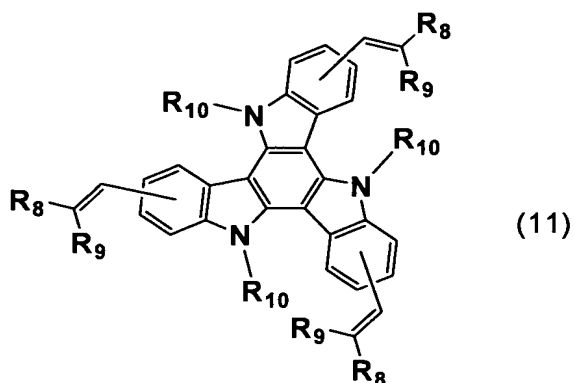
[formula 17]



(wherein R₈ is hydrogen or cyano group; R₉ is cyano group, carboxylic acid group, C1-C6 alkoxy carbonyl group, aryl group or substituted aryl group; and R₁₀ is C2-C12 alkyl group, substituted C2-C12 alkyl group, C2-C12 haloalkyl group or
 5 aryl C1-C6 alkyl group).

[9] A process for producing a Sym-triindole derivative represented by the following general formula (11)

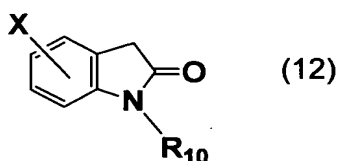
[formula 22]



(wherein R₈ is hydrogen or cyano group; R₉ is cyano group,

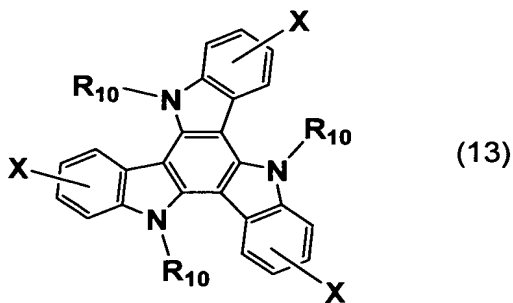
carboxylic acid group, C1-C6 alkoxy carbonyl group, aryl group or substituted aryl group; and R₁₀ is C2-C12 alkyl group, substituted C2-C12 alkyl group, C2-C12 haloalkyl group or aryl C1-C6 alkyl group), which process comprises reacting an
 5 oxyindole compound represented by the following general formula (12)

[formula 18]



(wherein R₁₀ has the same definition as given above and X is halogen) with a phosphorus oxyhalide to obtain a Sym-halo-
 10 triindole derivative represented by the following general formula (13)

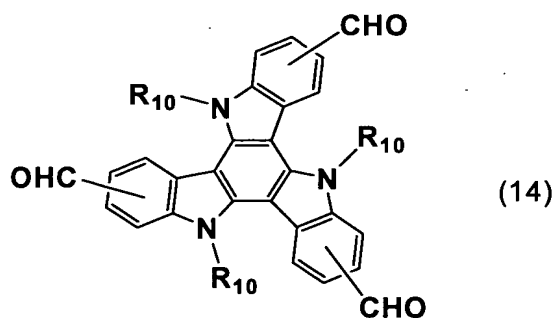
[formula 19]



(wherein R₁₀ and X have the same definitions as given above),

subjecting it to formylation with a formylating agent in the presence of butyllithium to obtain a Sym-formyltriindole derivative represented by the following general formula (14)

[formula 20]



5 (wherein R_{10} has the same definition as given above), and reacting it with a methylene compound represented by the following general formula (9)

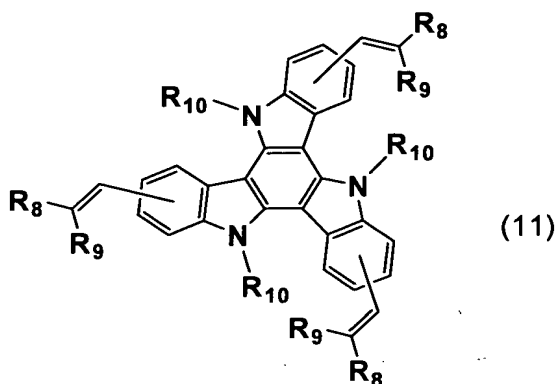
[formula 21]



(wherein R_8 and R_9 have the same definitions as given above).

10 [10] A process for producing a Sym-triindole derivative represented by the following general formula (11)

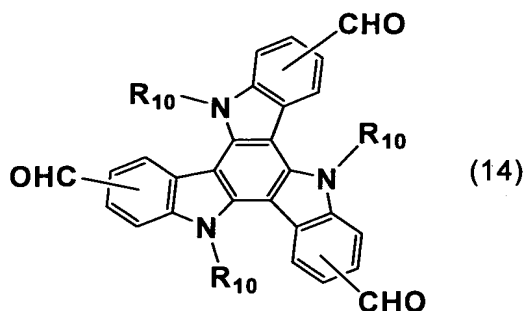
[formula 25]



(wherein R₈ is hydrogen or cyano group; R₉ is cyano group, carboxylic acid group, C1-C6 alkoxy carbonyl group, aryl group or substituted aryl group; and R₁₀ is C2-C12 alkyl group, substituted C2-C12 alkyl group, C2-C12 haloalkyl group or aryl C1-C6 alkyl group), which process comprises reacting a

5 Sym-formyltriindole derivative represented by the following general formula (14)

[formula 23]

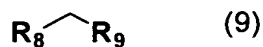


(wherein R₁₀ has the same definition as given above) with a

10 methylene compound represented by the following general for-

mula (9)

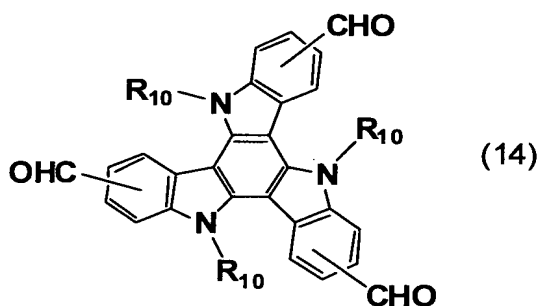
[formula 24]



(wherein R₈ and R₉ have the same definitions as given above).

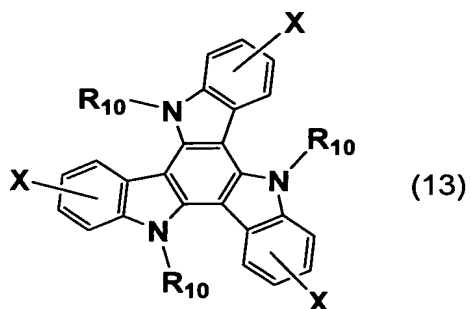
[11] A process for producing a Sym-formyltriindole deriva-
5 tive represented by the following general formula (14)

[formula 27]



(wherein R₁₀ is C2-C12 alkyl group, C2-C12 substituted alkyl
group, C2-C12 haloalkyl group or aryl C1-C6 alkyl group),
which process comprises subjecting a Sym-halo-triindole de-
10 rivative represented by the following general formula (13)

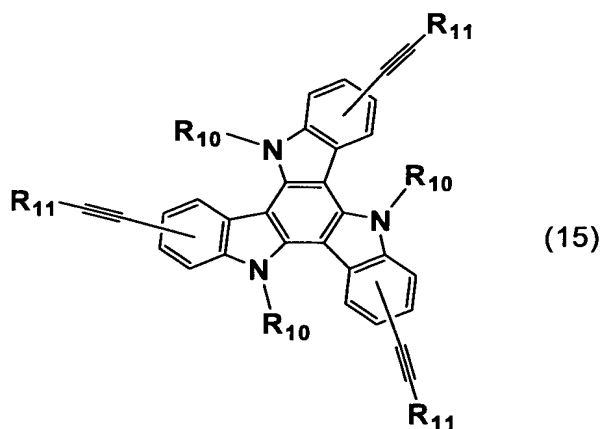
[formula 26]



(wherein R_{10} has the same definition as given above and X is halogen), to formylation with a formylating agent in the presence of butyllithium.

[12] A Sym-triindole derivative represented by the following
 5 general formula (15)

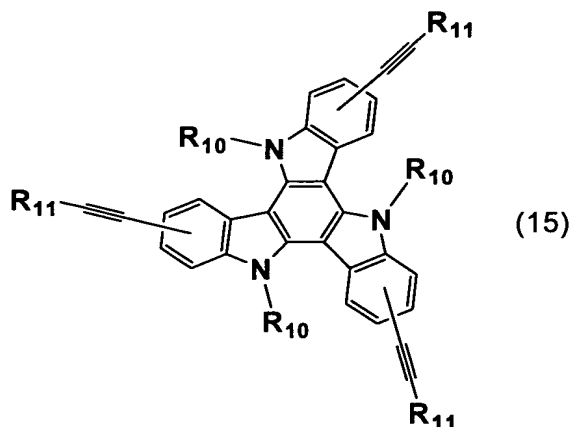
[formula 28]



(wherein R_{10} is C2-C12 alkyl group, C2-C12 substituted alkyl group, C2-C12 haloalkyl group or aryl C1-C6 alkyl group; and R_{11} is aryl group or substituted aryl group).

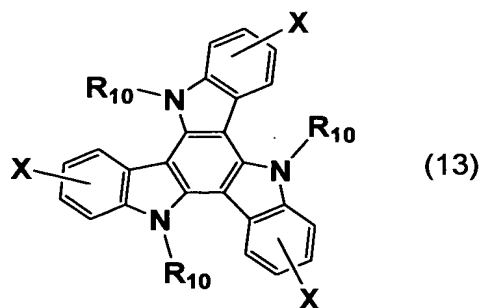
[13] A process for producing a Sym-triindole derivative represented by the following general formula (15)

[formula 31]



(wherein R₁₀ is C2-C12 alkyl group, substituted C2-C12 alkyl group, C2-C12 haloalkyl group or aryl C1-C6 alkyl group; and R₁₁ is aryl group or substituted aryl group), which process comprises reacting a Sym-halo-triindole derivative represented by the following general formula (13)

[formula 29]



(wherein R_{10} has the same definition as given above and X is halogen) with an acetylene derivative represented by the following general formula (16)

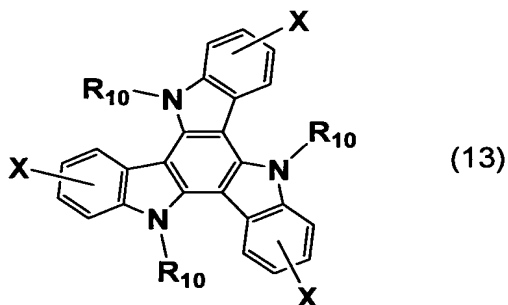
[formula 30]



5 (wherein R_{11} has the same definition as given above and R_{12} is hydrogen or trimethylsilyl group).

[14] A Sym-halo-triindole derivative represented by the following general formula (13)

[formula 32]



10 (wherein R_{10} is C2-C12 alkyl group, substituted C2-C12 alkyl group, C2-C12 haloalkyl group or aryl C1-C6 alkyl group; and X is halogen).